TECHNICAL NOTES

LAKE STATES FOREST EXPERIMENT STATION
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Measuring the Results of Aerial Spraying with Herbicides for Forestry Purposes

The use of herbicides applied from aircraft to control brush in ground preparation, plantation release, and other forestry projects has been increasing rapidly in the Lake States. However, most of the areas sprayed have received no more than a casual followup to determine results. The only sure way to learn what has been accomplished with the investment in spraying is to measure the herbicidal effects on the vegetation on a representative sample of the area sprayed; this should be done long enough after the spraying so that the effects are plainly visible.

A procedure that offers an easy and reliable means of sampling aerial brush control jobs is outlined below. Although other sampling schemes would likely prove just as effective, this particular approach is very flexible.

Field Work

1. Time of sampling--mid-July or later during the next growing season after spraying; this allows enough time for resprouting to show up.
2. Type of sampling--circular plots located by pacing along compass lines.
3. Size of plots--for low brush (up to 6 feet in height), 0.001 acre (plot radius 3.72 feet); for taller brush, 0.005 acre (8.33 feet); for trees, 0.05 acre (26.3 feet). These plots should be concentric if more than one class of brush is to be measured on an area.
4. Number of plots--size of sample needed depends on size of area sprayed and amount of kill. The following table provides a rough guide to the number of plots needed (fewer will be required where results are uniform, more where results are spotty):

Area (acres)	Estimated percent of kill			
	20	40	60	80
5	10	8	7	6
10	12	10	9	8
20	17	12	10	9
40	23	16	13	11
100	31	24	20	17
200	43	33	27	24
500	66	48	40	35

5. Distribution of plots--locate plots on lines 5 chains apart and perpendicular to the line of flight; distance between plots will depend on total number selected.

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6. Tallying--size up herbicide effect by tallying trees and brush present when spraying was done as "killed" or "not killed". On areas sprayed for low release or preplanting release, tally should also include new sprouts; on high release jobs, sprouts are usually of no significance and need not be recorded. If desired, a breakdown into the following classes may be used:

Height classes	Injury classes
Low brush--0.6 to 2.5 feet	Dead--80 percent or more defoliated
2.6 to 5.5 feet	Severe--50-80 percent defoliated
5.6 feet to 0.5 inch d.b.h.	Light--20-50 percent defoliated
Tall brush--0.6 inch d.b.h. and larger	None--less than 20 percent defoliated
Trees--by 2-inch d.b.h. classes	

Computations Needed

1. Determine the proportion of the total number of tree and brush stems that were killed.
2. Make plot-by-plot comparisons to determine uniformity of results.
3. If reaction to herbicide shows much variation, check location of plots on map to see if any pattern is involved.

Rating the Results

Standards of success of aerial brush control will vary with different organizations as well as with the different objectives sought. The following formula can be used to compare the percentage of kill desired with that actually obtained:

$$t = \frac{(p - P)\sqrt{n}}{\sqrt{pq}}$$

where P = desired minimum kill for effective results, and
p = actual kill, both expressed as percents;
q = $(100 - p)$, and
n = number of stems tallied.

A "t" value of more than 2.0 will mean that the results are significantly different from the desired minimum kill.

For example, on an aerial plantation release job of 200 acres where the kill desired was 70 percent, the 1,250 stems tallied (on 25 sample plots) showed an average kill of 64 percent. Substituting these values in the above formula,

$$t = \frac{(64 - 70)\sqrt{1250}}{\sqrt{64 \times 36}} = \frac{-6\ (35.36)}{\sqrt{2304}} = \frac{-212.16}{48.00} = -4.42$$

The estimated kill obtained is therefore significantly different statistically from that desired, and the job cannot be considered satisfactory.

Aerial Release Work

Aerial release may also be rated by comparing release need before and after spraying on 100 to 200 conifers. Select every second or third planted tree on each plot until the desired number is obtained. Then combine the data for all plots and determine the percentage of conifers needing release before and after spraying. Success can be rated on the basis of the number of trees that have been freed from overtopping competition and are still free 2 or more years after spraying.